GEM readout using an EMCCD: Test facility development and preliminary study

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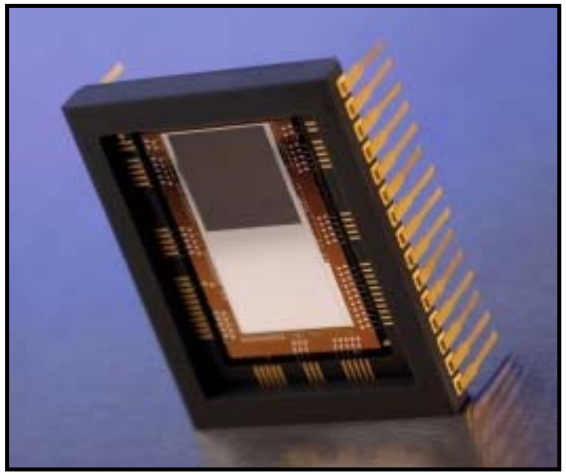
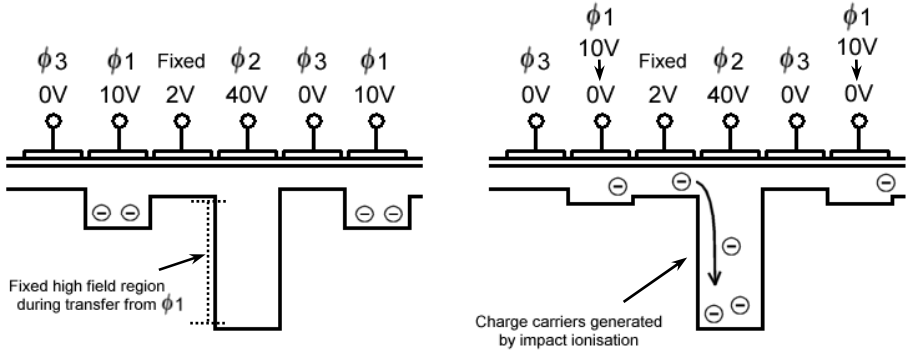
Talk Overview

- GEM readout using an EMCCD
- The CCD97 EMCCD
- The Brunel EMCCD Test Facility
- Preliminary GEM Testing
- Discussion

The CCD97 EMCCD

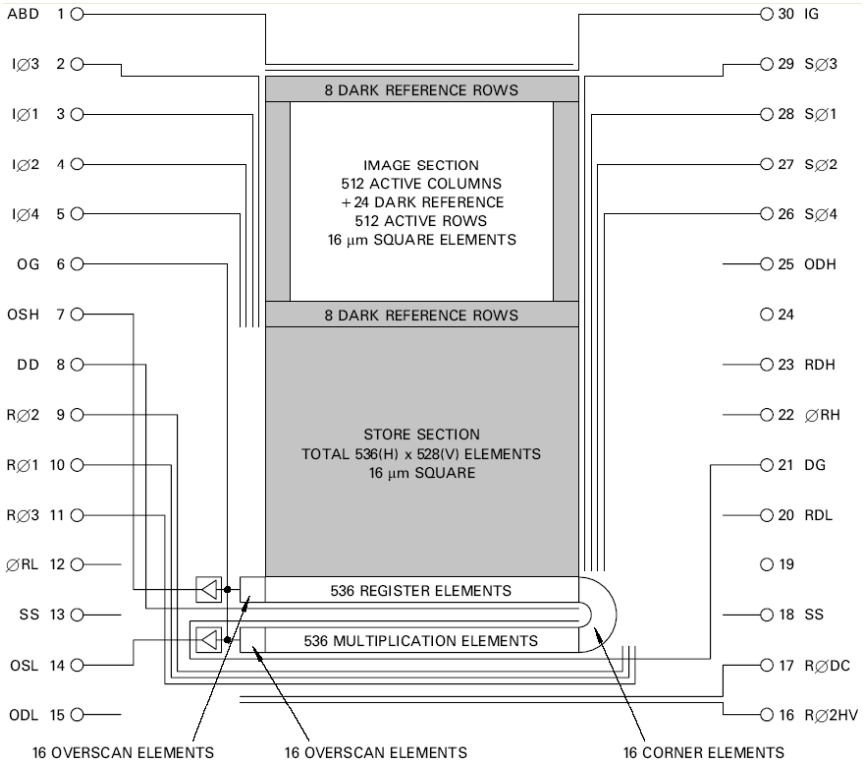
- Initially developed for night vision and security applications
- Use the principle of electron avalanche multiplication to greatly improve the visibility of faint objects

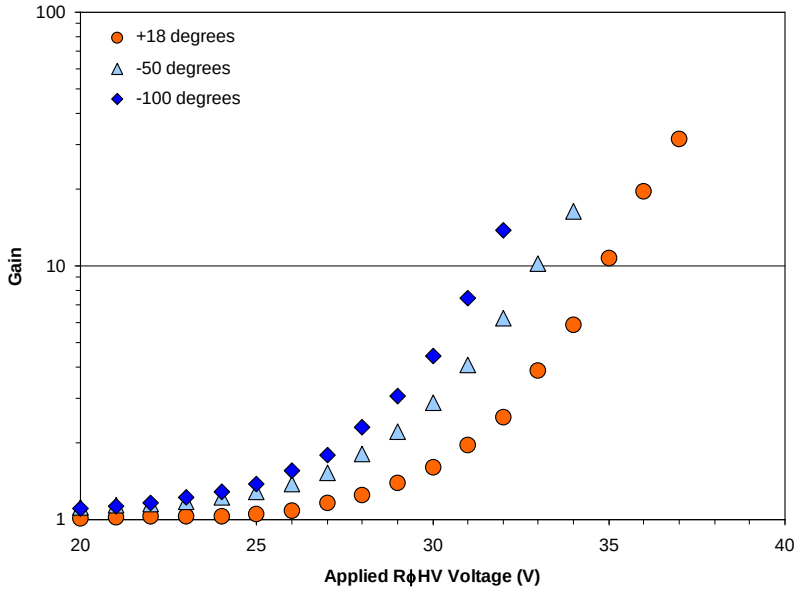




Parameter	*Value*
Operation	Frame Transfer
Active image area	8.192 mm × 8.192 mm
Image section	512 pixels × 512 pixels
Store section	536 pixels × 528 pixels
Pixel size	16 μm × 16 μm

The CCD97 EMCCD





The CCD97 EMCCD

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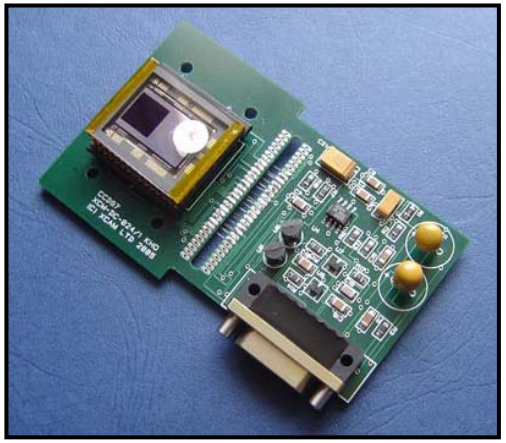
- Extensive experience with EMCCD operation and characterisation:
  - dedicated vacuum, cryogenic test facilities for optical / X-ray characterisation of CCDs over a wide range of temperatures
  - involvement with radiation qualification of EMCCDs for use in space
  - characterisation of high-resistivity EMCCDs giving greater signal gain at lower voltages



Clock/Bias	*Voltage (V)*
Image/Store	9.1
Serial	10.0
Reset	5.7
V_{od}	28.0
V_{rd}	19.5
V_{og}	2.5
V_{dd}	20.0
V_{ss}	9.0

Parameter	*Time (μs)*
Int+ delay	0.24
Int- delay	0.24
Int time	1.20

The EMCCD Test Facility

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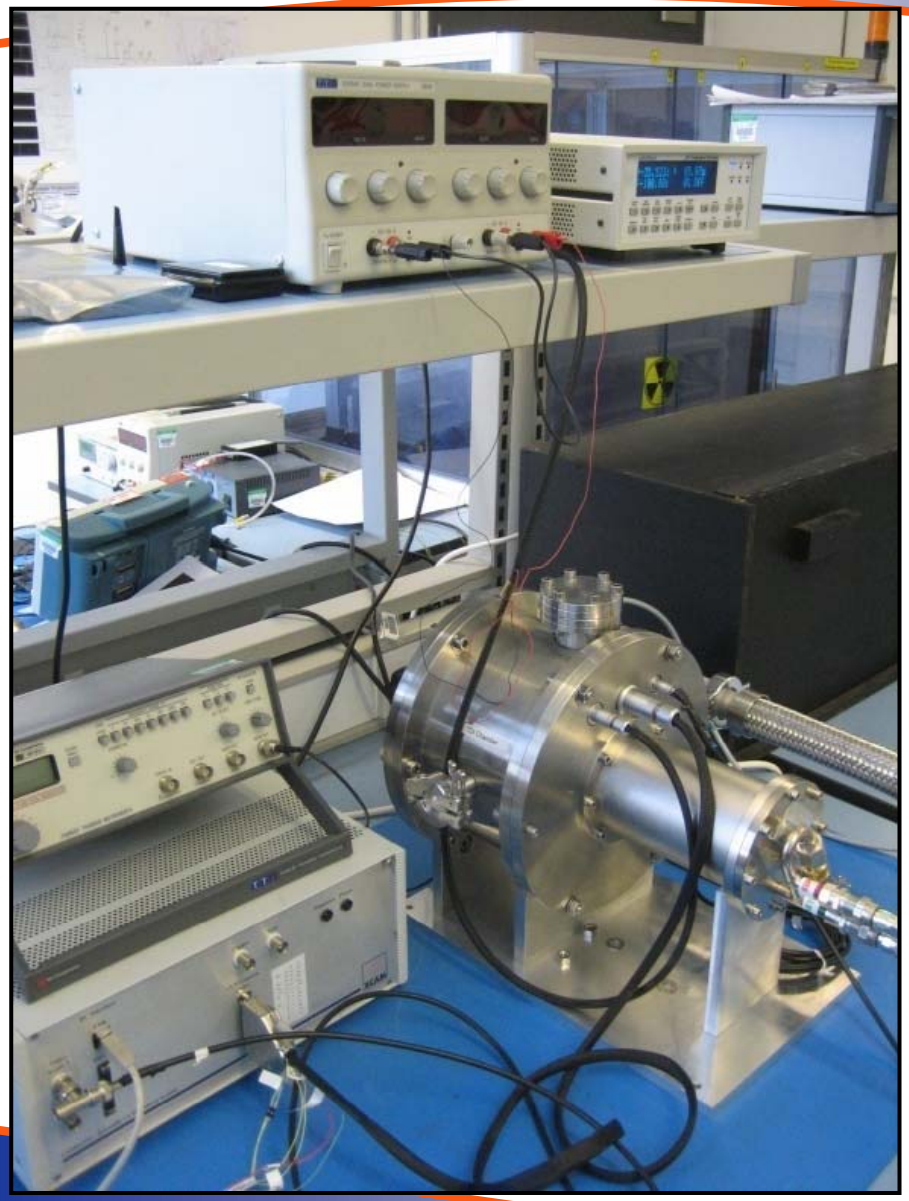
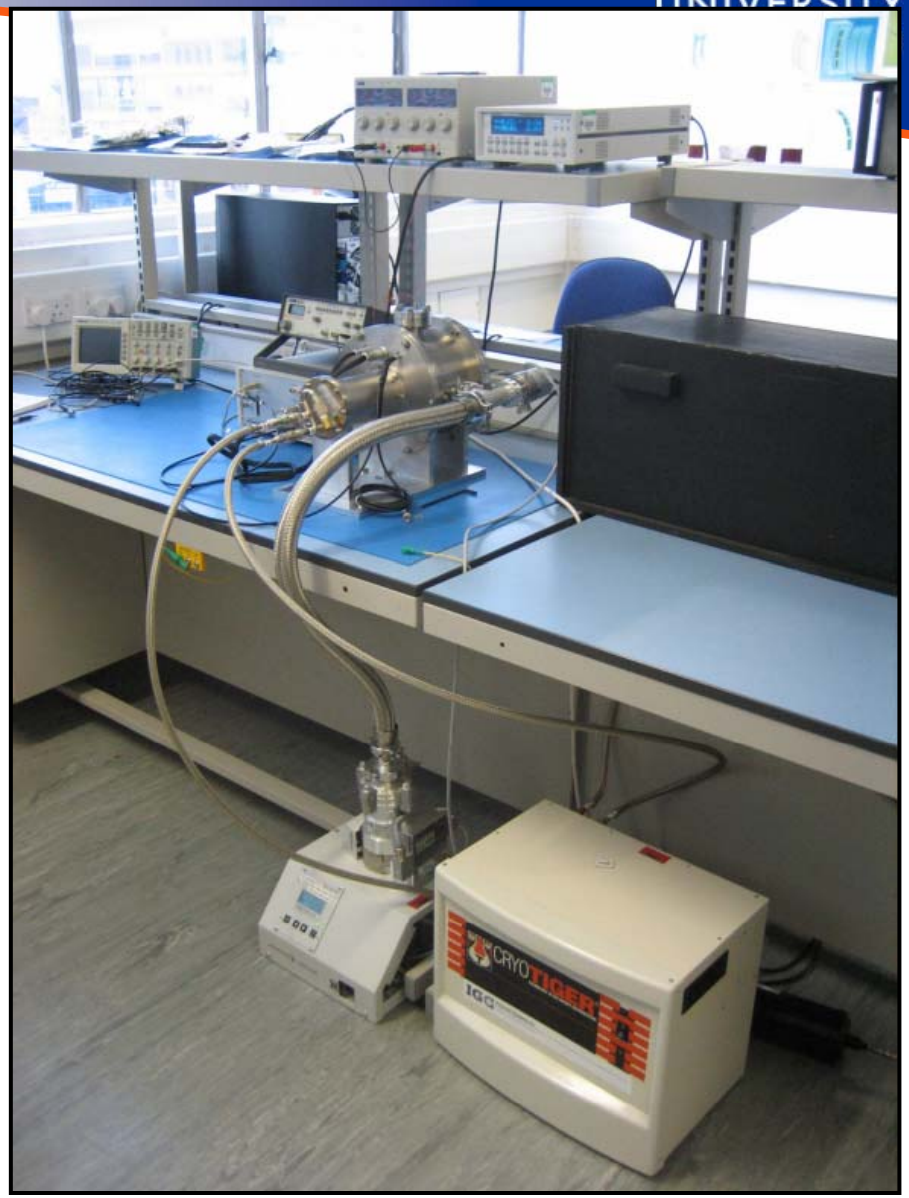
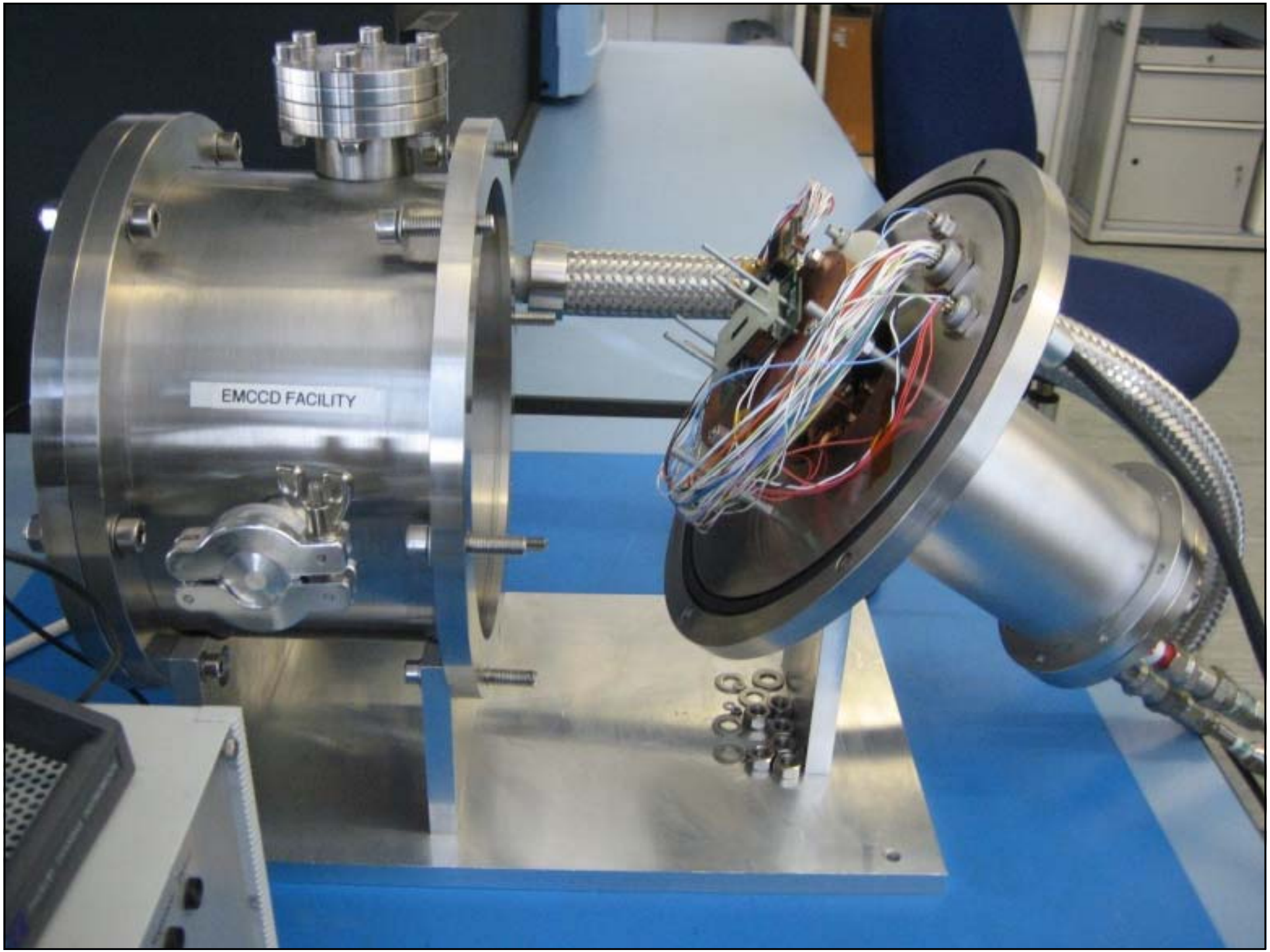
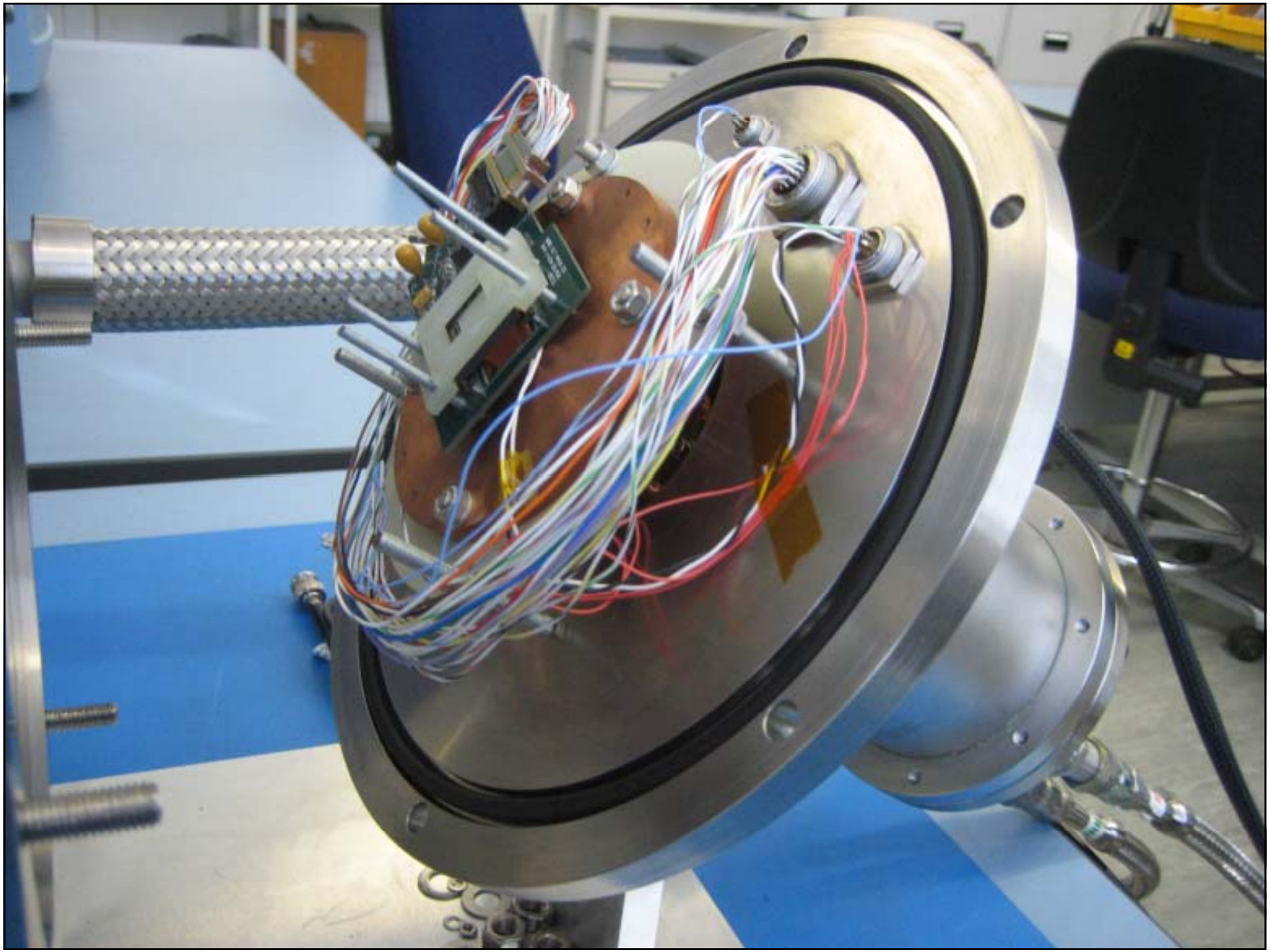
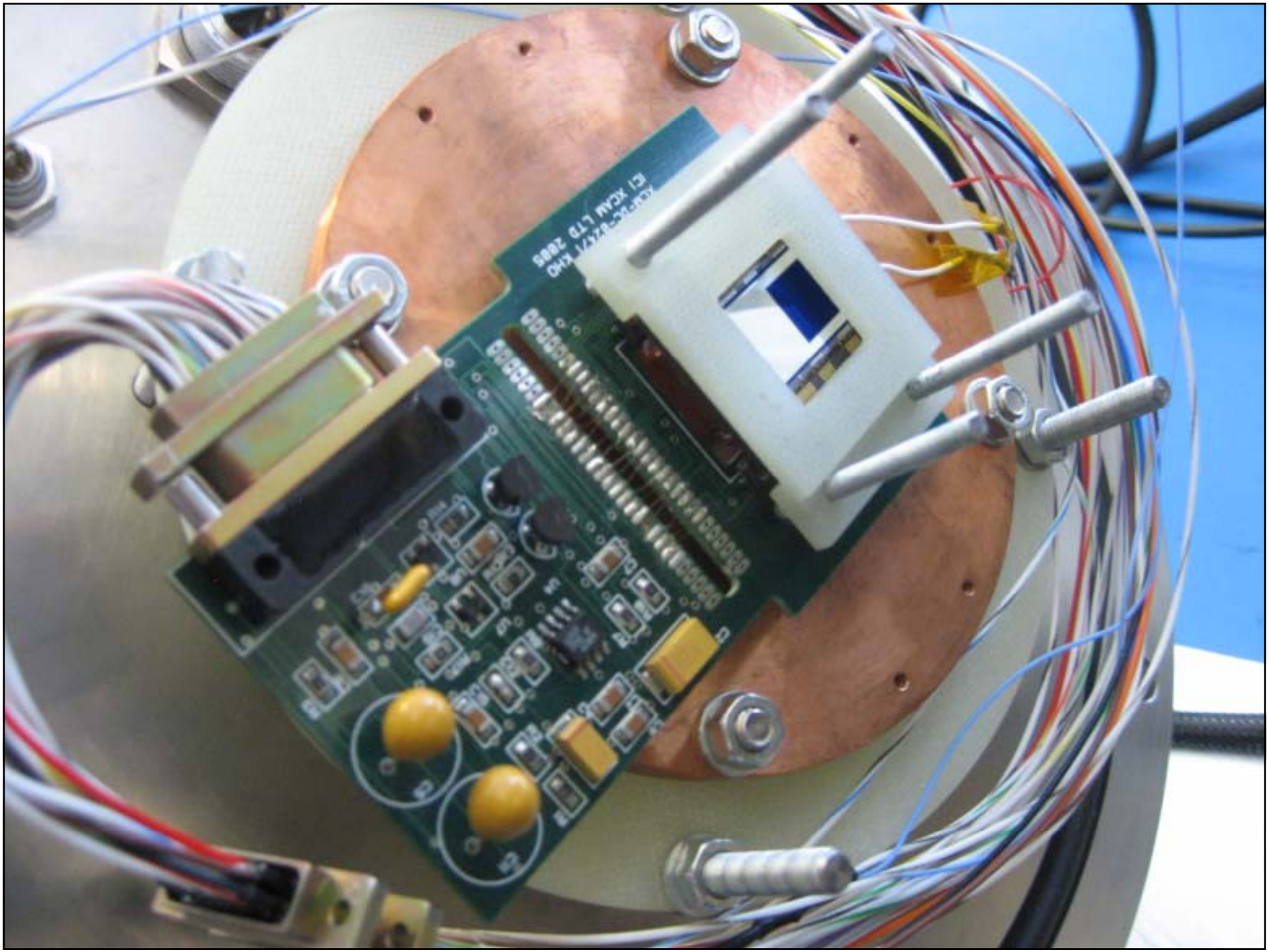
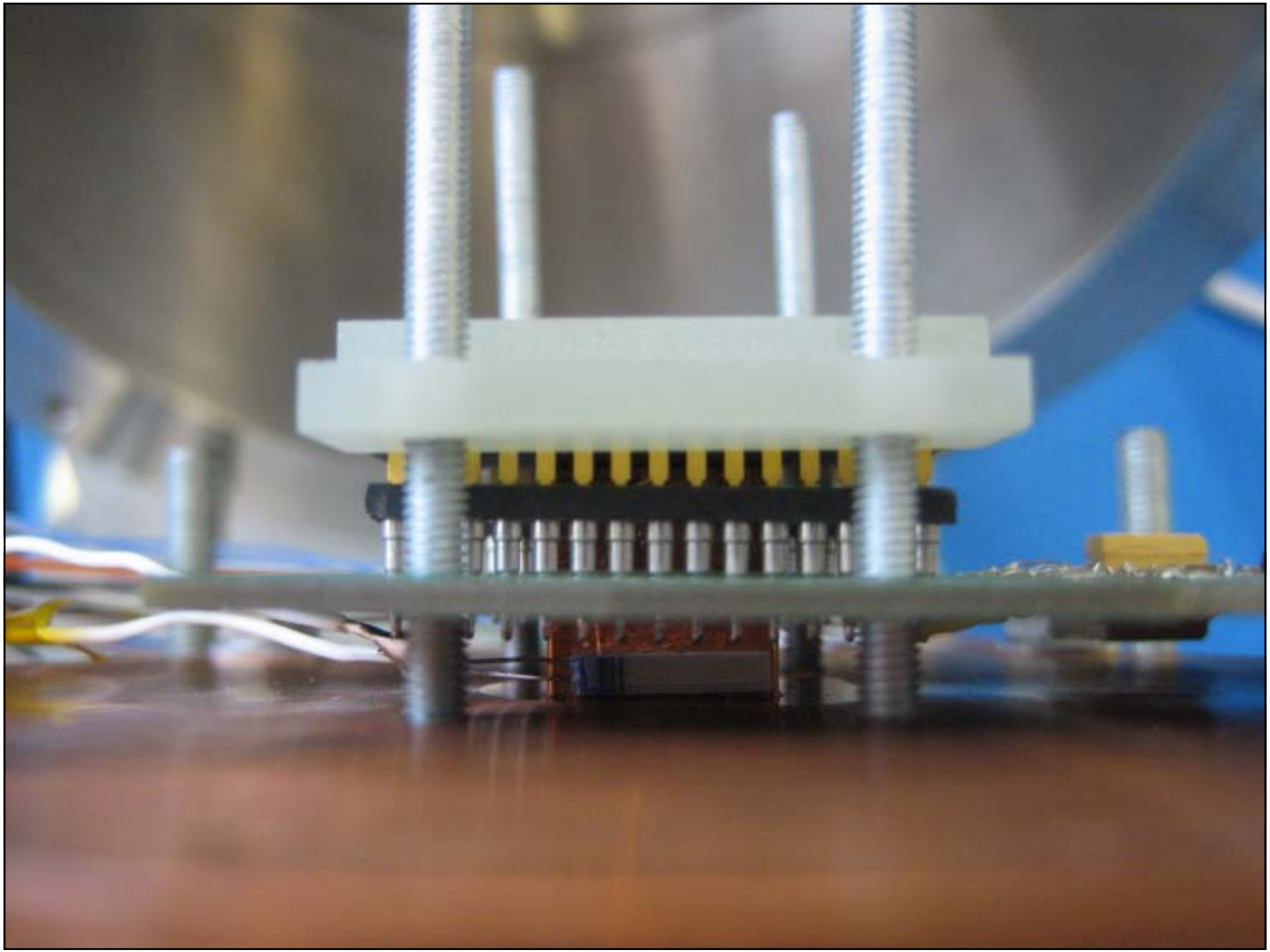





EMCCD FACILITY







Preliminary GEM Testing

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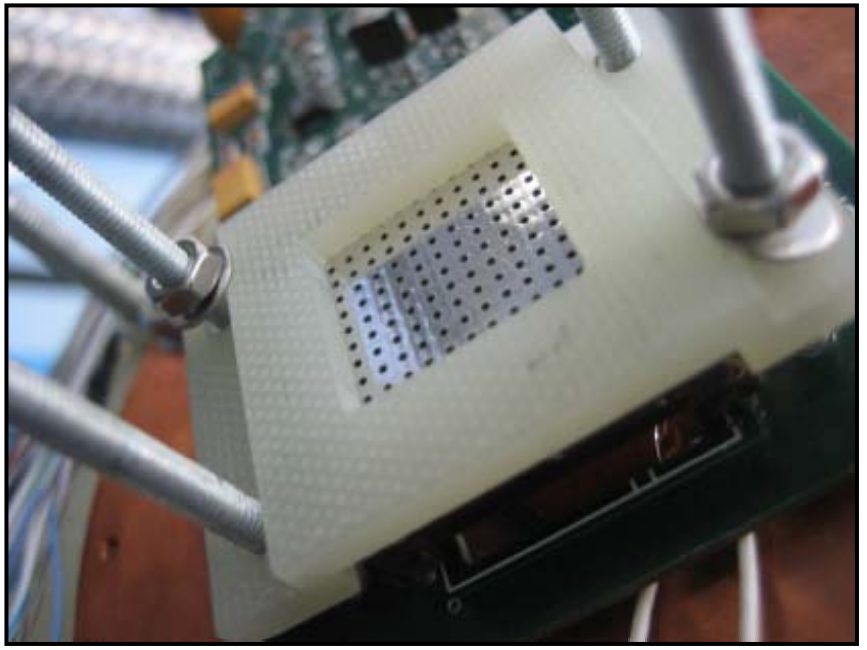
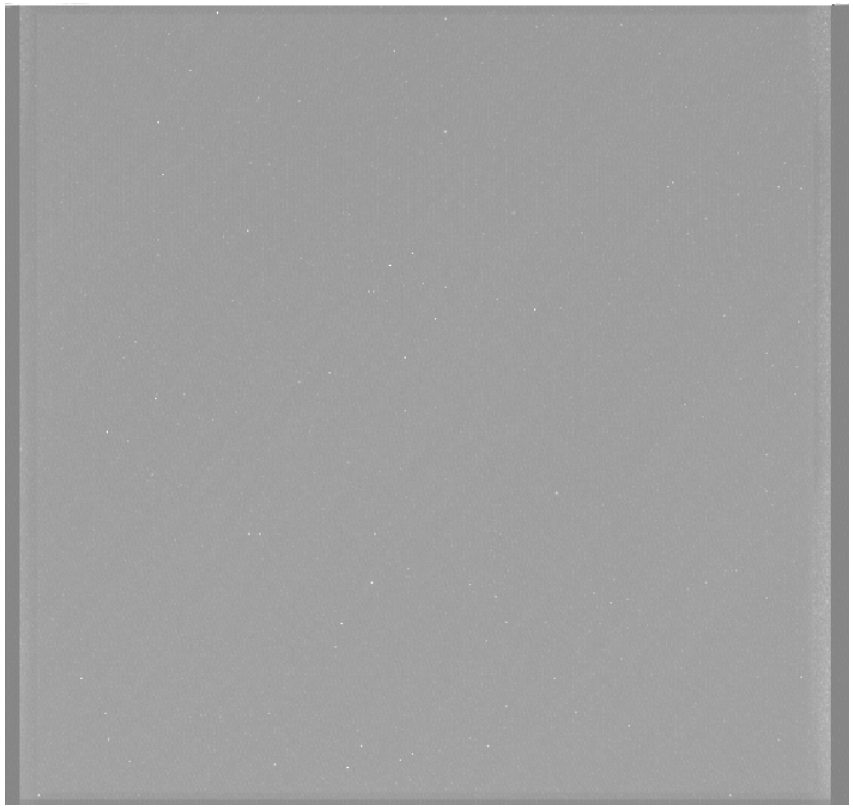
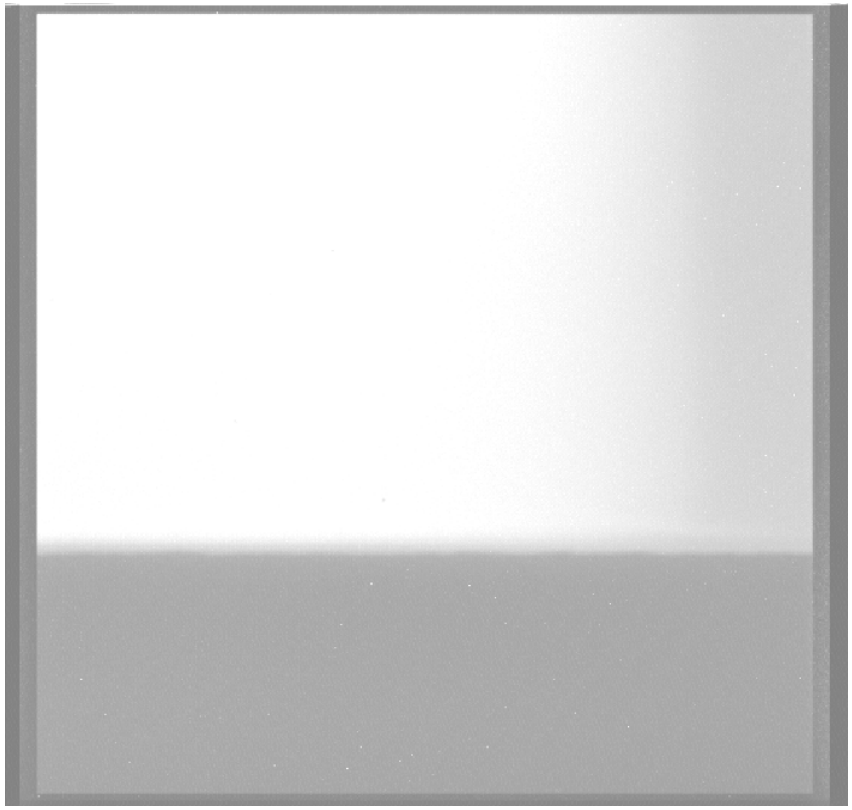
- Section of GEM clamped to CCD
- White LED used to provide illumination

Parameter	*Setting*
Frequency	400 kHz
V_{p-p}	2.9 V
DC offset	1.3 V
Shape	sine

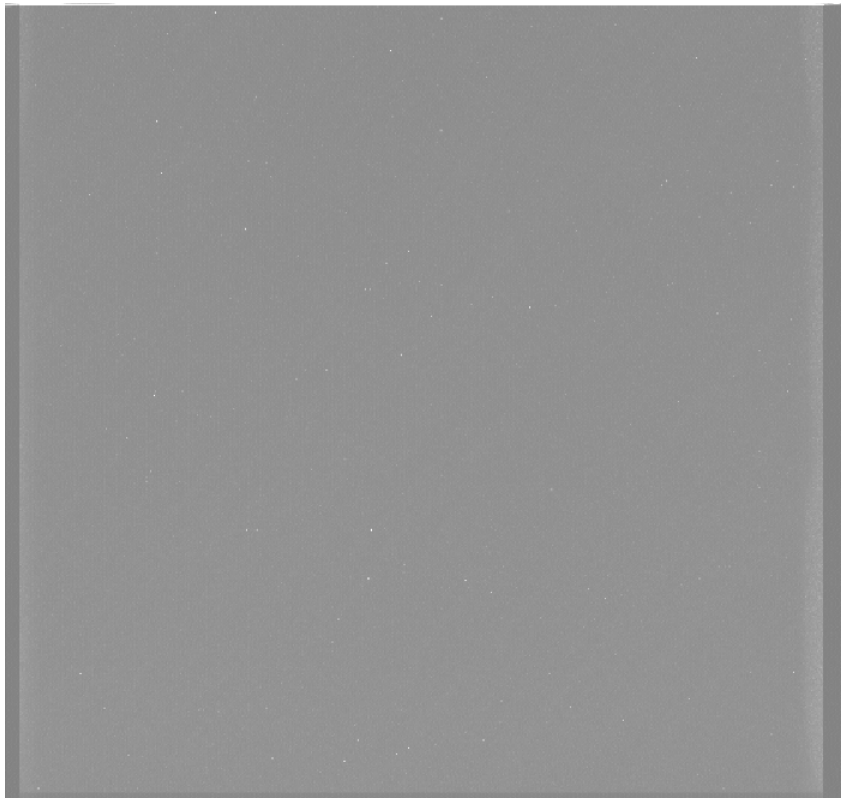


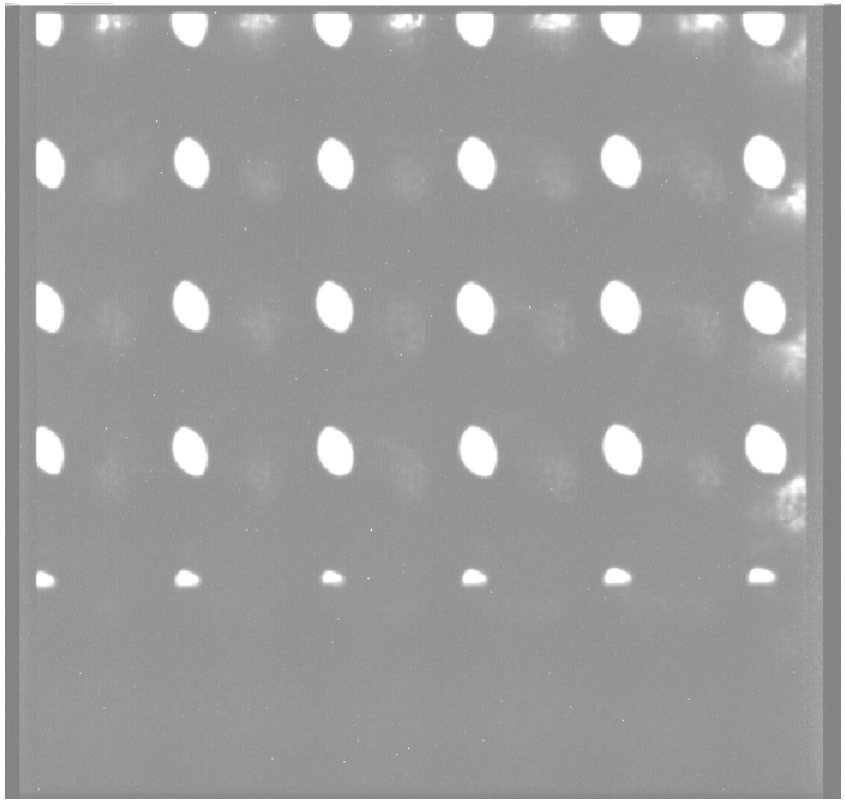
Room Temperature (no GEM)

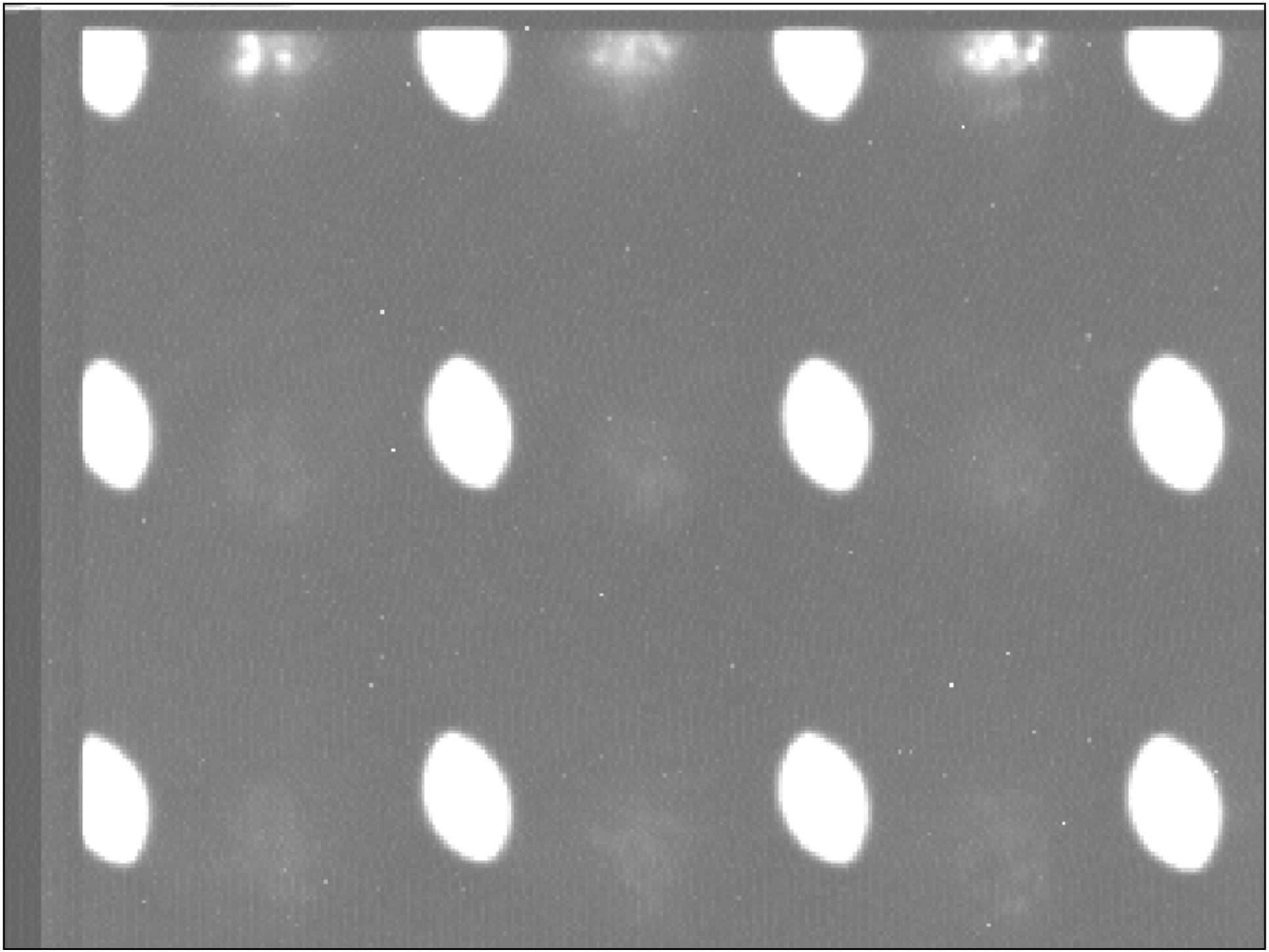




Room Temperature (with GEM)







Operating Cold

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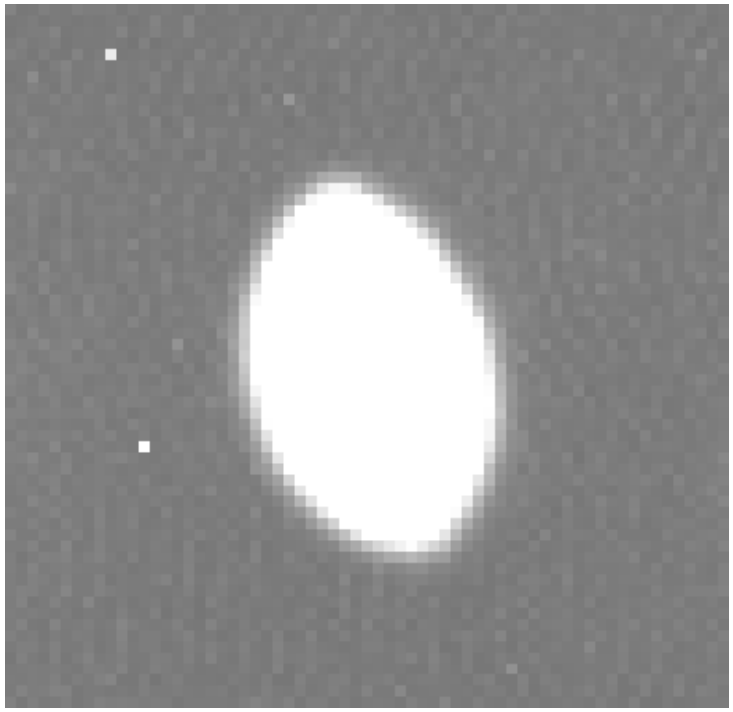
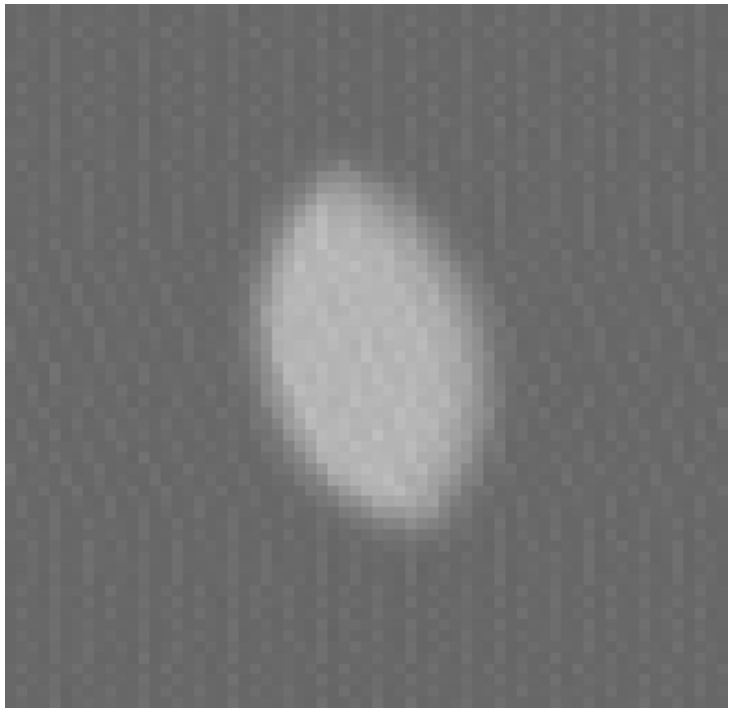


Room Temperature



-100 ^{o}C

Discussion

- Parameters for investigation:
  - Pixel readout rate
  - Illumination geometry
  - Temperature
  - Testing in argon
  - Testing with GEM operational
- System requirements:
  - Energy resolution?
  - Spatial resolution?
  - Readout rate?
  - Temperature?
  - Image size?

Acknowledgements

- **Gary Barker from Warwick University for providing the GEM array**
- **e2v technologies for provision of the EMCCD used in the presented study**